OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

April 23 - April 29, 1999

Summary 99-17

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Table of Contents

EVE	NTS	1
1.	IMPROPER RESPIRATOR CARTRIDGES ISSUED AND USED	1
2.	RADIOGRAPHERS RECEIVE UNPLANNED EXPOSURES	2
3.	LIFTING EQUIPMENT RATINGS EXCEEDED	5
4.	FALLING VENTILATION DUCT INJURES TWO WORKERS AT OAK RIDGE	6
5.	CORE DRILLERS PENETRATE AN ELECTRICAL CONDUIT	9
6.	NEAR MISS DURING RESTORATION OF STEAM SYSTEM	. 10
FINAL REPORT		. 12
1.	PERSONNEL CONTAMINATION MONITOR MODIFIED TO MORE RELIABLY DETECT PARTICLE CONTAMINATION ON SHOES	. 12

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EVENTS

1. IMPROPER RESPIRATOR CARTRIDGES ISSUED AND USED

On April 16, 1999, a waste verifier at the Savannah River Waste Vitrification Facility found five organic compound filter cartridges in a storage bin designated for high-efficiency particulate air (HEPA) filter cartridges only. He contacted the radiological controls supervisor out of concern that the wrong type of cartridge might have been issued for field use. The supervisor immediately searched used respirator storage locations in the facility and found four respirators fitted with the organic compound filters. By checking unique respirator numbers against log sheets and radiation work permits, the supervisor also determined that the four respirators had been improperly used in radiological areas. As a result of follow-up investigations, facility personnel do not believe that the occurrence resulted in any radioactive materials uptakes. However, it did seriously challenge employee health and safety. (ORPS Report SR--WSRC-WVIT-1999-0010)

Following the discovery, radiological controls personnel surveyed the four used filters and found no contamination. They also confirmed from a check of air monitor filter papers and survey logs that there had not been any airborne radioactivity during the work associated with the respirators. The four persons known to have worn the respirators were administered fast scan surveys, with negative results. Because the respirator cartridges come in boxes of 12, 3 are unaccounted for. Radiological controls personnel have identified a total of 12 more persons who were issued filter cartridge respirators and will administer fast scans for them.

The facility manager held a critique of this occurrence, and participants learned the following.

- The facility uses only two types of filter cartridges: organic compound/HEPA and paper/HEPA. The improper filters do not contain a HEPA filter component. A waste verifier who intended to order a box of organic compound/HEPA filter cartridges inadvertently ordered the wrong type by omitting an "H" suffix in the part number.
- The person who received the filters on April 1, 1999, probably placed them in a bin marked only as "Draegers" without checking the type or part number.
- Seven filters were issued and used on jobs, leaving the five that were discovered in the issue room.
- Respirator issuers receive training in the requirement to verify that correct respirators with correct cartridges are issued to qualified users. In this case, the issuers assumed that the storage bin contained the correct cartridges. Four different issuers are known to have issued the wrong respirator cartridge.

Qualified users are trained to inspect respirators issued to them to ensure that they
are correct for the assigned work. In this case, each user relied on the issuer to
perform the identification check.

The facility has developed the following corrective actions to address this occurrence.

- Check all bins in the respirator issue room to ensure that they contain the correct materials.
- Develop a visual aid that describes the checks to be made for respirators, including filters; post this aid at the issue room so that it is visible to both issuers and users.
- Emphasize this occurrence and lessons learned in shift orders and weekly shift briefings.
- Develop a job performance measure or other training enhancement that requires personnel in training to demonstrate the ability to verify respiratory protection equipment.
- Review and enhance labeling for storage bins in the issue room.
- Require waste verifiers to check individual filters against bin labels before placing them in bins.

This occurrence underscores the importance of attention to detail and adherence to procedures in every aspect of facility operation and maintenance that is important to human health and safety. Proper handling and storage of respiratory protection equipment is no less important than other areas such as fall protection or electrical safety. Respiratory protection program managers should evaluate respiratory protection training, qualification, procurement, storage, and issuing practices to ensure that they effectively preclude errors in issuing or use.

KEYWORDS: conduct of operations, filter, respiratory protection

FUNCTIONAL AREAS: Conduct of Operations, Radiation Protection

2. RADIOGRAPHERS RECEIVE UNPLANNED EXPOSURES

This week OEAF engineers reviewed Nuclear Regulatory Commission (NRC) Information Notice 99-04, *Unplanned Radiation Exposures to Radiographers, Resulting from Failures to Follow Proper Radiation Safety Procedures.* The NRC issued the information notice on March 1, 1999, as a reminder of the risk of unplanned high radiation exposures from radiography equipment and the need for proper radiation safety practices to prevent such exposures. The notice was prompted by a series of incidents that have resulted in unplanned exposures involving the failure to follow proper radiation safety procedures. Although these incidents did not result in radiation exposures that are expected to seriously affect the health of the exposed individuals, they had the potential for high exposures that could do just that. (NRC Information Notice 99-04)

The following are descriptions of the incidents that led to this information notice.

On December 31, 1998, at a temporary job site in Texas, a radiographer and his trainee were taking radiographs of pipes with a camera that had a 23-Ci iridium-192 source. The trainee shot the pictures, while the radiographer spent most of his time in the darkroom. At the end of the day, the trainee removed his thermoluminescent dosimeter (TLD) and his alarming dosimeter but kept his pocket ionization chamber in his pants pocket. The radiographer then told him that

they had to reshoot two pipes. When the trainee went to the camera to extend the source for the second reshoot, he found that he had forgotten to retract it into the camera. He received a whole-body dose of about 10 rem and a dose to the index finger of 3,000 to 5,000 rem. The dose to the index finger was high because the shots were being made without a collimator, which meant he had handled the end of the guide tube, with the source in it, without any significant shielding. Ten days after the incident, signs of radiation injury started to appear on his index finger. Investigators determined that although the trainee had a survey meter with him at the time of the shots, he did not use it.

- On November 20, 1998, at a refinery in Montana, two radiographers using an Amersham-660B camera with a 72-Ci iridium-192 source noticed that the source was not in the locked position while they prepared for a second shot. Their self-reading dosimeters were both off-scale. Investigators estimated that they were exposed to the unshielded source for about 6 min. Their film badges showed a whole-body dose of 4 rem to one of the radiographers and 12 rem to the other. Although they both wore their alarming ratemeters, one of the meters did not alarm and the other was turned off. Also, they did not use their survey meter after the first shot to confirm that the source was in the shielded position.
- On November 7, 1998, a radiographer and his assistant were taking radiographs of a large-diameter pipe at a temporary job site in Oklahoma. They used a Source Production and Equipment (Spec) camera with an 87-Ci iridium-192 source. They placed the camera inside the pipe to obtain panoramic views of some welds. At the end of one of the shots, the assistant crawled into the pipe to reposition the equipment for the next shot. When the assistant crawled back into the pipe to deactivate the automatic locking mechanism, she discovered that the source was not in the locked position. Her estimated dose was 11 rem to the whole body. Investigators determined that she did not perform a survey before approaching the source in the pipe nor did she wear an alarming ratemeter.
- On August 21, 1998, radiographers were performing radiography on pipe welds at a temporary job site in Indiana. They used a Spec 150 camera, with a 105-Ci iridium-192 source with a collimator. They had established a controlled area around the work site to keep unauthorized people out of the area. A radiographer inadvertently walked into the controlled area during one of the shots while the source was out of its shield. He was wearing a film badge but did not have an alarming ratemeter and did not carry a survey meter. Investigators estimated that his whole-body dose was 350 mrem and the dose to his right hand was 7 rem.

Radiographers should understand that without a survey meter or an alarming ratemeter, both of which are required equipment for radiography work, there is no way for them to be sure that the source in a radiography camera is not out of its shield when it should have been shielded. The dose from a typical radiography source, such as 100 Ci of iridium-192, is about 450 rem/hr at 1 ft (30.5 cm) from the unshielded source. A 40-sec exposure at 1 ft from the source would exceed the NRC's annual whole-body dose limit. A whole-body dose of about 250 rem would have a 50 percent chance of being fatal and could be delivered by a 100-Ci iridium source 1 ft away in about half an hour. Although such an exposure scenario is unlikely, it is possible in a situation where extended preparatory work is performed close to a camera with an unshielded source. Another type of severe injury that can result from exposure to such a source is that resulting from localized exposures, such as to the hands. For example, handling the guide tube with the source in it could result in dose rates, to the hand, on the order of 1,000 rad/min. Such dose rates could quickly lead to very serious injury to the skin and underlying tissues.

To avoid serious radiation injury, radiographers need to ensure that no one ever gets close to an unshielded radiography source. Radiography cameras are designed to keep the sources locked in their shields when not in use, but occasionally these locking mechanisms fail, because of mechanical problems or improper use. Also, one person could crank the source out of its shield without the knowledge of another person who later walks into the work area. In all these situations, there is usually no obvious indication that the source is unshielded. Without proper instruments, a person cannot know that a high radiation field exists in the area. For this reason, good radiation safety practices, as well as NRC regulations, require the use of radiation detection instruments to ensure that the source is securely in the shielded position after use and that it is safe to approach a radiography camera or a radiography work area.

Radiographers need instruments that provide an immediate indication that a high radiation field exists. Dosimeters, such as TLDs, film badges, and pocket dosimeters, do not do this. TLD and film must be sent away for processing, and pocket dosimeters, although they can be read in the field, do not give a sufficiently quick indication of a high radiation field. The only practical options available to the radiographer are survey instruments and alarming ratemeters. A radiation survey instrument (carried by the worker) has a meter that indicates the dose rate all the time it is in use. This is the best instrument to use to make sure it is safe to enter an area and to verify that the source is in the shield. However, sometimes it is necessary to set the survey instrument aside to prepare for the next shot or to reposition equipment or barriers. Even though the camera may not be in use at such times, it is still necessary to have an instrument that will continue to monitor for high radiation fields but does not need to be continuously looked at. The instrument for this purpose is the alarming ratemeter, which is usually worn on the radiographer's belt. This instrument is equipped with an audible alarm that sounds when the radiation field exceeds a preset level.

Survey instruments and alarming ratemeters can fail to work for a variety of reasons, or the meter may appear to be working but may be showing an incorrect dose rate reading. For this reason, and because of the serious dangers involved in using radiography sources, both instruments are required to be used during radiography. Although they serve different purposes, they act as backups to each other. The delicacy of these instruments requires them to be checked regularly to make sure they are still working properly. The batteries in both instruments should be checked to ensure they are in good condition and carry a sufficient charge. The survey instrument is functionally checked by holding it next to a check source and making sure it reads roughly the dose rate it should read in that position. The user must also be sure the instrument is set to the proper scale. Alarming ratemeters are checked by verifying that the alarm is set at the proper alarm set point and that it actually sounds when the meter is placed in a sufficiently high test radiation field.

In addition to using ratemeters and alarming dosimeters, radiographers should follow proper safety procedures when using radiography equipment. These include procedures for properly posting and roping off the work area; controlling access to the area during radiography; ensuring that the source is locked when it is retracted into the camera; periodically checking the camera to make sure that there is no apparent damage and that moving parts do not show undue wear; and ensuring that the equipment is in good mechanical condition and that it is operated properly.

KEYWORDS: exposure, radiation protection, radiographer, radiography

FUNCTIONAL AREAS: Radiation Protection

3. LIFTING EQUIPMENT RATINGS EXCEEDED

On April 12, 1999, at the Hanford 222-S Analytical Laboratory, riggers used a jib hoist and an elevated work platform (cherry picker) to lift three sample caves, each weighing more

than the rated capacity of the lifting equipment. On April 13, 1999, a chemical technologist noticed that the lift rating of the jib hoist was 2,000 lb. He later noticed that the data plate on one of the sample caves gave the weight of the cave as 2,350 lb. He recognized that the capacities of the lifting equipment had been exceeded on the previous day and informed the building operations manager of the issue. Investigators determined that the lift rating of the cherry picker was also 2,000 lb. Exceeding the rated capacity of lifting equipment can damage equipment or result in a dropped load. (ORPS Report RL--PHMC-ANALLAB-1999-0011)

Investigators determined that the lifting activities were controlled by a "No Planning Required" work package and that the crane and rigging organization considered the activities to be a routine lift requiring skill-of-the-craft. They also determined that the person in charge informed the riggers that each sample cave weighed approximately 1,200 lb based on information provided to him by the chemist responsible for the caves. Investigators determined that the person in charge looked for a data plate on the sample caves but he could not find it because it was not in a visible position.

The Hanford Site hoisting and rigging manual states that the rigger shall ensure that the rigging equipment and materials have the required capacity for the job and that all items are in good condition, are currently qualified, and are properly used. Planned corrective actions include performing annual tests, including load tests, on the jib hoist and the cherry picker. Additionally, the facility manager will consider issuing a standing automated job hazard analysis to be used in all work packages involving activities where mechanical devices are used to accomplish a lift.

NFS has reported the following events in which loads exceeded lifting equipment capacities in the Weekly Summary.

- Weekly Summary 97-44 reported that millwrights at the High Flux Isotope Reactor at the Oak Ridge National Laboratory lifted a pump motor that exceeded the posted load rating on a monorail hoist. The millwrights did not know the weight of the motor when they performed the lift. Drawings indicated that the motor weighed approximately 3,000 lb; the monorail and hoist had a capacity of 1 ton. (ORPS Report ORO--ORNL-X10HFIR-1997-0018)
- Weekly Summary 96-48 reported that a rigging crew at Hanford lifted a tank that exceeded the maximum rated capacity of the auxiliary hook on a 40-ton crane. The field superintendent calculated the weight of the tank to be 4,000 lb; the actual weight was 15,700 lb. The cable separated from its assembly, and the tank dropped 2 in. to the ground. (ORPS Report RL--BHI-NREACTOR-1996-0017 and Lessons Learned List Server 1996-RL-FDH-0058)

These events illustrate the importance of ensuring that a load does not exceed the rated capacity of the hoist or rigging equipment. The work package should have contained more detailed information. If the weights were known, they should have been noted in the work package. If the weights were unknown, it should have been stated that the weight of the items needed to be determined before performing the activity. DOE-STD-1090-96 (rev. 1), *Hoisting and Rigging*, provides guidance for hoisting and rigging and identifies related codes, standards, and regulations.

The following guidance applies to this event.

Section
 3.2.4, "Equipment/Rigging Selection," recommends determining the type, class,

and minimum capacity of lifting equipment (hoist, crane, forklift, etc.) required for the operation based on the identified load, task, and hazards.

- Section 8.5.2, "Size of Load," requires that personnel know the weight of the load and do not load the hoist beyond the rated capacity, except as provided for in section 8.3, "Testing."
- Section 8.5.6, "Ordinary Lifts," states that a designated leader shall ensure that the weight of the load is determined, that proper equipment and accessories are selected, and that the rated capacity of the hoist is not exceeded.

KEYWORDS: hoisting and rigging, lift

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety

4. FALLING VENTILATION DUCT INJURES TWO WORKERS AT OAK RIDGE

On April 22, 1999, at the Oak Ridge East Tennessee Technology Park, two BNFL Inc. senior journeyman sheet metal workers were injured while removing a 2,600-lb section of ventilation ductwork. A fork truck was supporting the free-hanging, 18-gage steel duct section when it fell to the floor. The workers had released the duct section from support rods when the load shifted forward and fell off the fork truck tines. As the ductwork fell, it struck the bucket of a manlift and moved it over several feet, forcibly jostling a worker in the manlift. An 80-lb piece of channel iron under the duct section fell vertically to the floor and tipped over, striking another worker in a different manlift on the front of his hard hat. Both workers were able to exit the work area to be treated by medical personnel. The worker who was in the manlift bucket experienced lower body stiffness in the hip area and the other worker required 10 stitches to close a forehead wound caused by the blow from the falling channel iron. This event is significant because a failure to observe safe hoisting and rigging practices can lead to the loss of positive load control and result in serious injury to workers. (ORPS Report ORO--BNFL-K33-1999-0004)

Investigators determined that the work crew had successfully removed over a mile of ductwork using the same work procedures. They also determined that the duct section was 22 ft to 24 ft above the floor when it fell, and it measured 11 ft by 5 ft by 11 ft long with an integral damper. The channel iron was one of two pieces being used to support the duct section on the fork truck tines. It measured 12 ft by 4 in. by 1-5/8 in. Facility managers and safety experts secured the location of the accident to facilitate a thorough investigation and suspended all other ventilation ductwork removal pending a review of the event. A multidisciplinary review team including representatives from Health and Safety, Engineering, Operations, Radiological Protection, and craft labor will analyze the event. Tentative corrective actions identified at a post-event critique include (1) strapping the duct section to the fork truck mast before releasing it from its holding rods and (2) increasing the number of channel iron supports.

NFS has reported loss of control of loads during hoisting and rigging operations in several Weekly Summaries. Some examples follow.

• Weekly Summary 98-26 reported two events involving personnel injuries that occurred during hoisting and rigging operations. At the Ashtabula Decommissioning Project, a subcontractor ironworker received multiple fractures to his leg when he tried to control a swinging bundle of structural steel beams being lifted by a crane. The load struck other structural steel components in the lay-down area, causing two pieces of steel to behave like scissors, pinching the right leg of the ironworker. At Lawrence Livermore National Laboratory a subcontractor steelworker was injured when his head was trapped between a steel

truss beam and an outrigger on a crane. He received lacerations to the temple area from his aluminum hard hat. (ORPS Reports OH-AB-RMI-RMIDP-1998-0003 and SAN-LLNL-LLNL-1998-0034)

- Weekly Summary 98-01 reported that riggers at the Hanford Site were lowering a
 drum onto a trailer when the drum slipped free of its rigging and fell over. A rigger
 working on the trailer bed jumped away from the falling load, fell off the trailer, and
 sustained a head injury. (ORPS Report RL--PHMC-FSS-1997-0030)
- Weekly Summary 96-51 reported that a construction worker at the Pantex Plant
 was injured when a 250-lb steel plate knocked him from a stepladder and he fell 4
 ft to the floor. Two construction workers were lifting the plate with a hand-operated
 chain hoist. The chain was not properly rigged, and it came loose when one of the
 workers shook the load to clear an obstruction. (ORPS Report ALO-AO-MHSM-PANTEX1996-0239)

OEAF engineers also reviewed the following two events this week involving forklift safety and operation.

- On April 23, 1999, at the Hanford Site, a vendor performing maintenance on a
 forklift identified forklift extensions that were not stamped or labeled and had no
 written approval for use granted by the forklift manufacturer. The use of an
 unapproved lifting device violates OSHA regulations and DOE and Hanford
 hoisting and rigging standards. (ORPS Report RL--PNNL-PNNLBOPER-1999-0012)
- On April 19, 1999, at the Los Alamos National Laboratory, a forklift operator contacted a hanging communications cable with the forklift's mast while maneuvering towards a load. Although the force of the impact snapped a support cable and broke a utility pole crossarm, the communications cable did not break. Investigators determined that the equipment move had been planned and walked down, and that spotters were required. They also determined that the forklift operator, without spotters, used a larger forklift than anticipated. During the walk-down, the forklift that would be used during the move was not available to allow comparing its size to that of the surrounding area. The communications cable was suspended at a height of 14 ft, and the mast on the larger forklift extends approximately 16 ft vertically with the forks still positioned near the ground. Following the event, the employees who performed the walk-down stated that they had failed to see the low-hanging communications cable. (ORPS Report ALO-LA-LANL-CHEMLASER-1999-0003)

These events illustrate the importance of observing safe hoisting and rigging practices. Personnel using a forklift to raise, suspend, and move material secured by rigging to forklift tines must understand the basic safe work practices for these maneuvers and must have experience and proficiency in forklift operation.

All personnel involved in hoisting and rigging and the use of forklifts should understand the following references.

- OSHA regulation 29 CFR 1910.178, Powered Industrial Trucks, contains safety requirements related to the maintenance and use of platform lift trucks and fork trucks (forklifts), including operator training requirements. This regulation can be found at http://www.osha-slc.gov/OshStd_data/1910_0178.html.
- DOE-STD-1090-96, rev. 1, *Hoisting and Rigging*, section 3.2, "Operation Evaluation," states that personnel must determine the consequences of a collision

or an upset or of the dropping of a load. Section 3.3, "Lifting Fixtures," governs the design, fabrication, maintenance, and control of special lifting fixtures and rigging accessories. Chapter 10 and Section 15.5.3, "Forklift Trucks," provide direction concerning forklift operations.

DOE Office of Oversight publication Independent Oversight Special Study of Hoisting and Rigging Incidents Within the Department of Energy, October 1996, analyzes DOE hoisting and rigging incidents between October 1, 1993, and March 31, 1996. It shows that three out of four hoisting and rigging incidents resulted in accidents (defined as fatalities, personal injuries, or property damage). Forklifts caused about one-third of all hoisting and rigging incidents and 38 percent of all accidents. Ninety percent of all forklift incidents resulted in an accident. Inattention to detail and procedures not used or incorrectly used are responsible for most forklift incidents. This special study can be found at http://nattie.eh.doe.gov/web/eh2/reviews/hoist_rig.html.

KEYWORDS: forklift, hoisting and rigging, rigging

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety

5. CORE DRILLERS PENETRATE AN ELECTRICAL CONDUIT

On April 19, 1999, at the Mound Plant, site craftsmen penetrated a conduit containing four energized 110-V ac circuits while core drilling a concrete floor. The craftsmen were performing remodeling activities to relocate an environmental laboratory. Although the Mound Project Superintendent and craftsmen discussed the progress of the work during a pre-job briefing, they did not discuss the core drilling operation or use a pre-job checklist, which would have required them to obtain the necessary permit for core drilling. Because they did not obtain the permit, the area to be drilled was not scanned for hidden utilities. Although no injuries occurred during this event, penetrating hidden utilities during construction can cause serious injury and disrupt facility services. (ORPS Report OH-MB-BWO-BWO03-1999-0001)

The craftsmen were drilling a 2-in. diameter hole through a 6 in. to 8 in. thick concrete floor. The floor thickness was marked on the drill bit and a putty dam was constructed around the penetration to hold water for drill-bit cooling and dust abatement. Investigators determined that after drilling approximately two-thirds of the way through the floor, the water inside the dam suddenly disappeared into the hole and the craftsmen saw sparks. They stopped drilling, removed the drill, and discovered that the drill bit had penetrated a 1-in. electrical conduit embedded in the floor and that the water had flowed into the conduit. Investigators and craftsmen believe that the sparks were the result of drill-bit-to-conduit contact and were not electrical sparks. Ground fault interruption circuits protecting the drill and electrical circuits did not trip. Facility management held a critique of this event and is requiring all craftsmen, superintendents, and foremen to attend refresher training on permits and pre-job briefing requirements. The Project Superintendent and craftsmen involved in the event received this instruction before they restarted their project.

NFS continues to report avoidable events involving the penetration of hidden utilities during construction and dismantling/decommissioning activities. Some examples follow.

 Weekly Summary 99-07 reported that at the Rocky Flats Environmental Technology Site, telecommunications technicians drilled into two energized 120-V ac electrical lighting circuits while installing a telephone line in a new trailer. Before drilling, the technicians performed a skill-of-the-craft visual inspection and concluded that no wiring was present near the drilling location. Investigators determined that their inspection did not use specific directions from work package instructions, diagrams, or procedures. They also determined that the integrated work package for installing the trailer failed to require anyone to use a utility locator before drilling to determine if electrical wiring was present in the trailer wall. (ORPS Report RFO--KHLL-779OPS-1999-0007)

- Weekly Summary 98-43 reported that a construction subcontractor at the Idaho National Engineering Environmental Laboratory Test Reactor Area severed an energized 220-V ac, 20-amp evacuation siren electrical circuit while drilling through a composite steel/masonry block wall. Investigators determined that the conduit was concealed between the exterior steel siding and the building masonry block. (ORPS Report ID--LITC-TRA-1998-0019)
- Weekly Summary 98-29 reported that a maintenance pipe fitter at the Idaho National Engineering and Environmental Laboratory drilled through an interior wall into a sanitary water drain line and nearly hit an electrical conduit. Investigators determined that attendees at the pre-job briefing did not discuss the work order requirement for a subsurface survey. They also determined that the pipe fitter was unaware that the subsurface survey permit applied to the work because he believed that it applied only to ground penetration work. (ORPS Report ID--LITC-LANDLORD-1998-0023)

These events continue to draw attention to the importance of using effective work control practices and detailed pre-job planning. Pre-job briefings, facility procedures, and training programs should emphasize the hazards associated with penetrating building surfaces. Work packages must be detailed enough to clearly identify the permits required for intrusive work and must clearly state who is responsible for securing permits. Where configuration knowledge is limited, metal detectors or other equipment or methods should be used to confirm utility locations before penetrating building surfaces. A safety and health hazard analysis must be included in the work control process to help prevent worker injury and should provide for job-specific walk-downs and the use of equipment to detect embedded utilities.

Facility managers, program and project managers, and project personnel should review and incorporate the following in their surface-penetration permitting process.

- 29 CFR 1910, subpart S, "Electrical," describes work practices to be employed to
 prevent injuries when work is performed near or on equipment or circuits that are
 or may be energized.
- 29 CFR 1926, Safety and Health Regulations for Construction, paragraphs .651(b) and .416(a)(3), assign responsibility to employers for identifying energized circuits near the work area.
- Lessons Learned Report, Issue 98-02, *Penetrating Hidden Utilities*, includes lessons learned from events that involved cutting and drilling into utilities concealed behind walls, floors, and ceilings. It also describes a number of techniques for avoiding hidden utilities and includes useful references.

OSHA regulations are available at http://www.osha-slc.gov/OshStd_data. Lessons learned reports are available at http://www.tis.eh.doe.gov/web/oeaf/ lessons_learned/reports/.

KEYWORDS: drill, electrical safety, hazard analysis, industrial safety, penetration

FUNCTIONAL AREAS: Construction, Industrial Safety, Work Planning

6. NEAR MISS DURING RESTORATION OF STEAM SYSTEM

On April 19, 1999, at the Pantex Plant, a construction contractor who was working on a steam system in a facility discovered utility operators restoring it to operation while the system was still being worked on. The construction contractor had just returned from a break, intending to complete installation of a steam valve in a pipe, when he saw the utility operators. He advised them that he had not completed work on the pipe and had not asked for the steam to be restored. The utility operators and the contractor locked out the appropriate steam system valves and the contractor completed his work. Deficiencies in the lockout/tagout process and communication errors resulted in a misunderstanding regarding the status of the steam system work. Although no personnel were exposed to steam, admitting steam into the system could have resulted in a leak with the potential for injury. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0033)

The facility was in the repair mode and facility managers had authorized the work on the steam system, which involved installing new valves in a drip valve station. The steam system normally operates at approximately 230 degrees Fahrenheit. The work was being performed downstream of several pressure-reducing stations, where pressure would be approximately 40 psi. Utility operators performed the lockout/tagout of the system, which was controlled by a lockbox. The contractor's supervisor was the only one who hung his lock on the lockbox. The contractor who actually performed the work did not hang a lock.

Investigators determined that someone (not yet identified) had called and asked for removal of the lockout and restoration of the steam system. They also determined that the supervisor had removed his lock from the box at the end of the day because he did not want to be called back in the evening to remove it. When the utility operators went to restore the system they saw that the supervisor's lock had been removed, adding credence to their belief that the restoration had been authorized.

Facility management conducted a critique of the event on April 20. Critique members decided to review the existing lockout/tagout process and address any deficiencies. In the meantime, (1) only the supervisor may authorize restoration of locked-out systems during contractor work and (2) all personnel involved in the work activity must hang a lock.

This event illustrates the importance of maintaining effective control of lockouts and tagouts. If the construction contractor had hung a lock on the lockbox while he performed his work, the utility operators would not have been able to restore the system even if the supervisor had removed his lock. Also, if the supervisor was going to be unavailable to support the lockout, he should have officially relinquished that responsibility to another control authority who was in position to sign off on the work and authorize removal of the lock. It is also important to walk down equipment or systems to verify that they are ready to be placed into service. In this event, an open piping system could have resulted in the release of hazardous energy.

OSHA regulation 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*, section (f)(3)(ii)(D), states that each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, provides guidance and good practices for lockout/tagout from an operational standpoint. The following sections apply to documentation and removal of lockouts and tagouts.

 Section 4.4.2, "Documentation of Lockout/Tagout," states that a lockout/tagout that involves multiple energy-isolating devices, or that will be used by several individuals or work groups, should document the following activities as they apply: authorization, placement of locks and tags, verification of effectiveness, acceptance by individual workers or work group representatives, release by workers at the completion of the job, authorization for removal of locks and tags, and restoration to operable condition.

Section 4.5.2, "Release and Removal of Lockout/Tagout," states that before
releasing a lockout/tagout, the individual or work group representative should
check to see that the machine or equipment is operationally intact. It is not safe to
remove the lockout/tagout if further work must be performed to make the
equipment operational. Only after all affected individuals and work group
representatives have released a lockout/tagout may the operations organization
remove the tags (and locks, if used) and place the equipment in an operational
condition.

Other guidance on lockouts and tagouts can be found in the following documents.

- DOE O 5480.19, Conduct of Operations Requirements for DOE Facilities, chapter IX, "Lockouts and Tagouts."
- DOE/EH-0540, Safety Notice 96-05, Lockout/Tagout Programs.
- 29 CFR 1926.417, Lockout and Tagging of Circuits.

KEYWORDS: construction, lockout and tagout, steam

FUNCTIONAL AREAS: Conduct of Operations, Construction, Industrial Safety

FINAL REPORT

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. PERSONNEL CONTAMINATION MONITOR MODIFIED TO MORE RELIABLY DETECT PARTICLE CONTAMINATION ON SHOES

After conducting tests to determine why a personnel contamination monitor (PCM-1B) did not detect a particle of contamination on a reactor operator's shoe, health physics personnel at the Brookhaven National Laboratory High Flux Beam Reactor (HFBR) recommended a modification to their PCM-1Bs. They determined that the design of the PCM-1B allowed the foot to be placed so that the sole of the shoe fell too far beyond the outside edge of the holes in the foot plate, under which the detectors are located. A spacer bar installed against the wall of the foot plate solved the problem. (ORPS Report CH-BH-BNL-HFBR-1998-0002)

On February 13, 1998, a reactor operator alarmed the HFBR facility north exit portal monitor (PM-7). The PM-7 detected a particle of contamination on the bottom of one of his shoes, near the shoe's outer edge. The particle (cobalt-60) measured approximately 24,000 dpm by direct frisk. The operator had been removing and relocating shield blocks using a fork truck on the equipment level of the facility. He exited the equipment level and cleared a PCM-1B. He proceeded to the operations level, where he alarmed a PM-7. Health physics personnel instructed him to survey using the operations level PCM-1B. He cleared the PCM-1B but eventually alarmed the PM-7 at the north exit of the HFBR.

It became evident to health physics personnel that PM-7s detected the particle on the shoe and that PCM-1Bs did not. They conducted a test by attaching a small check source to the side of a shoe and placing the shoe on the PCM-1B foot plate to simulate the actual condition. They found that the PCM-1B failed to alarm if they placed the edge of the shoe snugly against the wall of the foot plate, while the PM-7 alarmed in all cases. To correct the PCM-1B problem, facility personnel, in consultation with Eberline (the manufacturer), installed a spacer bar against the wall of the foot plate of each of the PCM-1Bs (see figures 1-1, 1-2, and 1-3). This prevents a shoe from being placed too far beyond the outside edge of the detector holes in the foot plate.

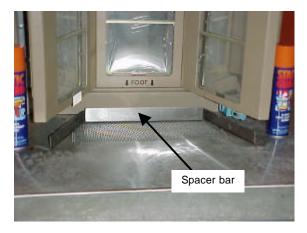




Figure 1-1. Spacer Bar Installed on Foot Plate Figure 1-2. Shoe Positioned on Foot Plate



Figure 1-3. PCM-1B Personnel Contamination Monitor

Investigators determined that the direct and root causes of the contamination event involving the cobalt-60 particle were legacy contamination. Before a comprehensive radiological controls program was implemented in the early part of this decade, discrete particles of cobalt-60 had been dispersed within the HFBR facility. A major cleanup of the facility in 1990 removed the vast majority of the particles. However, legacy particles have not been eliminated altogether. Investigators believe the reactor operator probably picked up a legacy particle when he worked on the equipment level. They also determined that the problem with the PCM-1B was a contributing cause of the event. Corrective actions included continuation of the HFBR's aggressive contamination control program and the installation of a spacer bar on the foot plate of the PCM-1Bs.

This event illustrates how testing can help to identify a design or system problem. Other DOE facilities that use Eberline PCM-1B personnel contamination portal monitors may benefit by checking them for the foot plate problem described in this report.

KEYWORDS: contamination, Eberline, personnel monitoring, radiation monitoring

FUNCTIONAL AREAS: Lessons Learned, Radiation Protection